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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Paper No. 14

Application Number: 09/775,370
Filing Date: February 01, 2001
Appellant(s): ZHENG ET AL.

Peter Zawilski
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed on 01/27/2003.

(1) *Real Party in Interest*

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

The brief does not contain a statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief. Therefore, it is presumed that there are none. The Board, however, may exercise its discretion to require an explicit statement as to the existence of any related appeals and interferences.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

Appellant's brief includes a statement that the claims as now presented stand or fall together.

(8) *Claims Appealed*

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) *Prior Art of Record*

US 5,959,357

Korman

09-1999

(10) Grounds of Rejection

The rejection of claims 28-32, 34 and 36 under 35 U.S.C. 112 paragraph, have been withdrawn.

Claims 27-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Korman (US 5,959,357) in view of Green et al. (US 4,851,895).

Regarding claim 27, Korman (see attached fig. 3) shows a semiconductor device comprising:

- A first metal portion 16 over a substrate;
- A dielectric layer 44 above the first metal portion;
- A second metal 42a portion above the dielectric layer;
- A single layer plug 42b extending from the first metal portion through the dielectric layer to the second portion.

Moreover, the plug has a first upper surface 42c extending laterally beyond the second metal portion and substantially planar to an upper surface of the dielectric layer and a second upper surface 42d that extends above the first upper surface (see attachment). The single layer plug is made of copper (col. 5/ll. 23). Korman does not disclose that an aluminum alloy can be used to make the single layer plug. Green discloses the interchangeability between aluminum alloy and copper as metallization materials. Moreover, Green discloses that the metallization materials suitability depend on the material properties such as, e.g. electrical conductivity, electrical contact.

resistance stability of such electrical properties over time, physical integrity and adhesion, and the availability of a suitable etchant in photolithographic processing (col. 1/lls. 21-30). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make Korman's single layer plug of aluminum alloy because copper and aluminum alloy exhibit similar physical properties (e.g. electrical conductivity, electrical contact resistance and stability) which make them interchangeable metallization material as suggested by Green.

In regards to claims 28-32, Korman shows that the single layer plug comprises a first and second portion. Korman shows that the single layer plug is a single piece. Therefore, Korman's device does not exhibit any type of interface. Moreover, a "product by process" claim is directed to the product *per se*, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which make it clear that it is the final product *per se* which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935). Note that Applicant has burden of proof in such cases as the above case law makes clear.

Regarding claim 33, Korman shows that the dielectric layer 44 is a single layer dielectric.

Regarding claim 34, Korman shows that the dielectric layer has an upper surface. Korman does not disclose which process was used to make the dielectric layer. Moreover, a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which make it clear that it is the final product *per se* which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935). Note that Applicant has burden of proof in such cases as the above case law makes clear.

Regarding claim 35, Korman shows that the plug does not exhibit any void.

Regarding claim 36, Korman shows that the second upper surface of the single layer plug is substantially planar with a second upper surface of the second dielectric layer 44.

Regarding claim 37, Korman shows that the portion of the dielectric layer including the second upper surface has a side wall portion SD2 that is substantially

aligned with a first side wall portion of the second metal layer SD1, and wherein the portion of the plug including the second surface has a side wall SD3 portion that is substantially aligned with the second side wall portion of the second metal layer SD1.

(11) Response to Argument

ISSUE 1:

Appellant argues:

Reference '357 (Korman) does not teach a single plug since it appears to be a two-layer plug. Also, appellant submits that a lower portion of the "single plug layer plug 42b" below surface 42c would apparently have to be formed prior to an upper portion thereof that is above the surface 42c because the upper portion of the plug is tapered at the surface 42c. As col. 5/lis. 36-39 and fig. 3 of '357 reference indicated, the portion "single layer plug 42b" is in face comprises separated vias 46.

Examiner responds:

Initially, the term "single plug" is interpreted as an electrical connection consisting of one part that connects two integrations levels. Korman figure 3 depicted an electrical device comprising several elements including an electrical connection 42b consisting of one-piece of copper that connect the first metal portion 16 and the 42a (col. 5/lis. 19-23 and attached figure 3). Appellant's interpretation of "an apparent two layer structure" is misplaced and unsupported since Korman specification does not disclose that the layer 42b is made or can be made by the method proposed by appellant. Moreover, the layer 42b as shown in attached figure 3 does not show any type of interface, border, division or physical boundary that would make one having ordinary skill in the art to conclude that this layer is not a single plug. It is respectfully noted that in theory any element can

be divided into an infinite number of infinitesimal segments. Nevertheless, these divisions have to base on real and physical boundaries.

Appellant argues:

The examiner does not assert, nor does it appear, that the upper surface of 42c is substantially planar to an upper surface of the dielectric layer 44.

Examiner responds:

As shown in the attached figure 3, the single plug structure disclosed by Korman has two-step surfaces : 1) a first upper surface 42c and 2) a second upper surface 42d. The first upper surface 42c is considered coplanar with the top surface of first insulating layer 44 because both surfaces are extended along the same horizontal plane.

Appellant argues:

The examiner's assertion that the "single layer plug 42b" is a single layer is misplaced when it fact, the "single layer 42b" includes multiple vias as discussed above and acknowledged by the Examiner Office Actions.

Examiner responds:

Initially, the term "via" is understood as a hole or cavity made through an insulating layer to allocate a plug or plug portion. The fact that the plug 42b fills several vias (i.e. the vias of layers 44) does not opposed to the fact the layer 42b is a single layer plug. Moreover, none of the Office Actions acknowledges that the single plug 42b includes multiple vias.

Appellant argues:

The "single layer 42b" would include an interface between multiple vias, and the Office Action's rationale on page 6 that the device of '357 (Korman) does not exhibit any type of interface is unsupported".

Examiner responds:

As shown in the attached figure 3 and stated above, Korman teaches a "single plug" that does not include any type of physical interface. Moreover, appellant rationale about "possible interfaces" is based on unsupported interpretation of Korman's disclosure.

ISSUE 2:

Appellant argues:

The Office Action does not advance the argument that the asserted prior art either recognize or addresses the problem discussed by Appellant when conventional metal are used in this environment.

Examiner responds:

The fact that appellant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Appellant argues:

Korman '357 reference expressly indicates that the preferred material for its alleged corresponding via is not aluminum but rather is copper: each of layer 38, 40 and 42 (including the material for the alleged corresponding via) "are preferably copper" along with metal pad 22 and copper post 36 (see, col. 5/lls. 4-51). Use of copper material for these interconnects, allegedly corresponding vias and pads, is directly associated with the purpose of the alleged invention of Korman '357 reference, this purposed being "to provide FET array employing high density interconnect (HDI)" to overcome disadvantage of device element interconnection including excellent electrical conductivity (see col. 3/lls. 5-27). HDI circuits do not employ the type of aluminum base via structure as asserted in the Office Action.

Examiner responds:

In response to appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Although Korman discloses that copper is the preferred material Korman's invention is not limited to copper. It is implicit from the teachings of Korman that other conductive materials known in the art can be effectively used as metallization layers as long as they provide an excellent electrical conductivity (see col.3/lis. 9-14). Moreover, Appellant's admitted prior art discloses that copper and aluminum are common interconnection materials (see Appellant's Specification page 1, lines 19-20).

Appellant argues:

Contrary to the suggestion in the Office Action, the Green '895 reference does not teach that copper and aluminum are interchangeable for either the above disused purpose of the Korman '357 reference or for problem addressed in Appellant's Specification.

Examiner responds:

Initially, Green teaches that the material selection for metallization layer is a matter of design choice whereas Korman teaches a metallization structure made by a conductive material such as copper. The suitability the metallization material depends on a number of material properties such as electrical conductivity, electrical contact resistance, stability or electrical properties over time, physical integrity and adhesion strength, and the availability of a suitable etchant in photolithographic processing (col. 1/lis. 21-30). Also, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed

invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, to use aluminum instead of copper is within the general knowledge of a worker in the art because they are art recognized equivalents as taught by Green and by Appellant's admitted prior art (see Appellant's Specification page 1, lines 19-20). Furthermore, Appellant clearly admits that the use of aluminum by itself does not solve problems set forth in Appellant's Specification (see paper 13, page 6, lines 7-9).

Appellant argues:

The Office Action is completely silent on the purpose for interchanging aluminum and copper which, by itself should be taken has an acknowledgment that the evidence is lacking

Examiner responds:

In paper no. 9, page 5, paragraph 14 the Examiner asserted "Green discloses the interchangeability between aluminum alloy and copper as metallization materials. Moreover, Green discloses that the metallization materials suitability depend on the material properties such as, e.g. electrical conductivity, electrical contact resistance stability of such electrical properties over time, physical integrity and adhesion, and the availability of a suitable etchant in photolithographic processing (col. 1/lls. 21-30)"

Appellant argues:

The Examiner has entirely ignored the problems discover, discussed and addressed by Appellant's claimed invention and has also entirely ignored the problems being addressed by the prior art.

Examiner responds:

The fact that appellant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). Note that Korman in view of Green teaches all the limitations of claimed in claim 27.

ISSUE 3:

Appellant argues:

The problem addressed by the cited art and the claimed invention are entirely different and thereby rebut any argument that the skilled artisan would be led to implement the modification as has asserted since Korma is applicable to the building an array of "one or more off the shelf field effect transistor whereas Appellant's claimed invention is directed to a monolithic IC design and the solving of its interconnection challenges.

Examiner responds:

The problem addressed by the cited art and the claimed invention are considered similar and analogous since both belong to the same field of endeavor (i.e. semiconductor technology). Also, both inventions disclose a semiconductor device made by vertical stacking conductive lines having interconnections or plugs forming circuit pathways (see Appellant's Specification page 1, lines 14-20 & Korman, col.3/lis. 9-14). Additionally, Korma's invention is directed to a monolithic IC design (see figs. 3 and 4).

Appellant argues:

The Examiner's proposed modification undermines the purpose of the Korman '357 reference therefore the rejection cannot be maintained:

Examiner responds:

The teachings of Green (i.e. use of aluminum instead of copper) do not undermines the purpose of Korman since it is implicit from the teachings of Korman that other conductive materials known in the art can be effectively used in their invention as long as they provide an excellent electrical conductivity (see col.3/lis. 9-14).

ISSUES 4 and 5:

Appellant argues:

The 112(1) and 112 (2) rejections are improper.

Examiner responds:

The rejection of claims 28-32, 34 and 36 under 35 U.S.C. 112 paragraph, have been withdrawn.

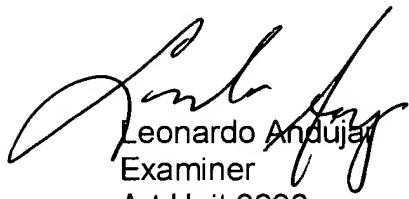
For the above reasons, it is believed that the rejections should be sustained.

An appeal conference was held on 02/20/2003 with Mr. Leonardo Andújar (Patent Examiner), Mr. Olik Chaudhuri (Supervisory Patent Examiner), and Nathan J. Flynn (Supervisory Patent Examiner), as the conferees.

Respectfully submitted,

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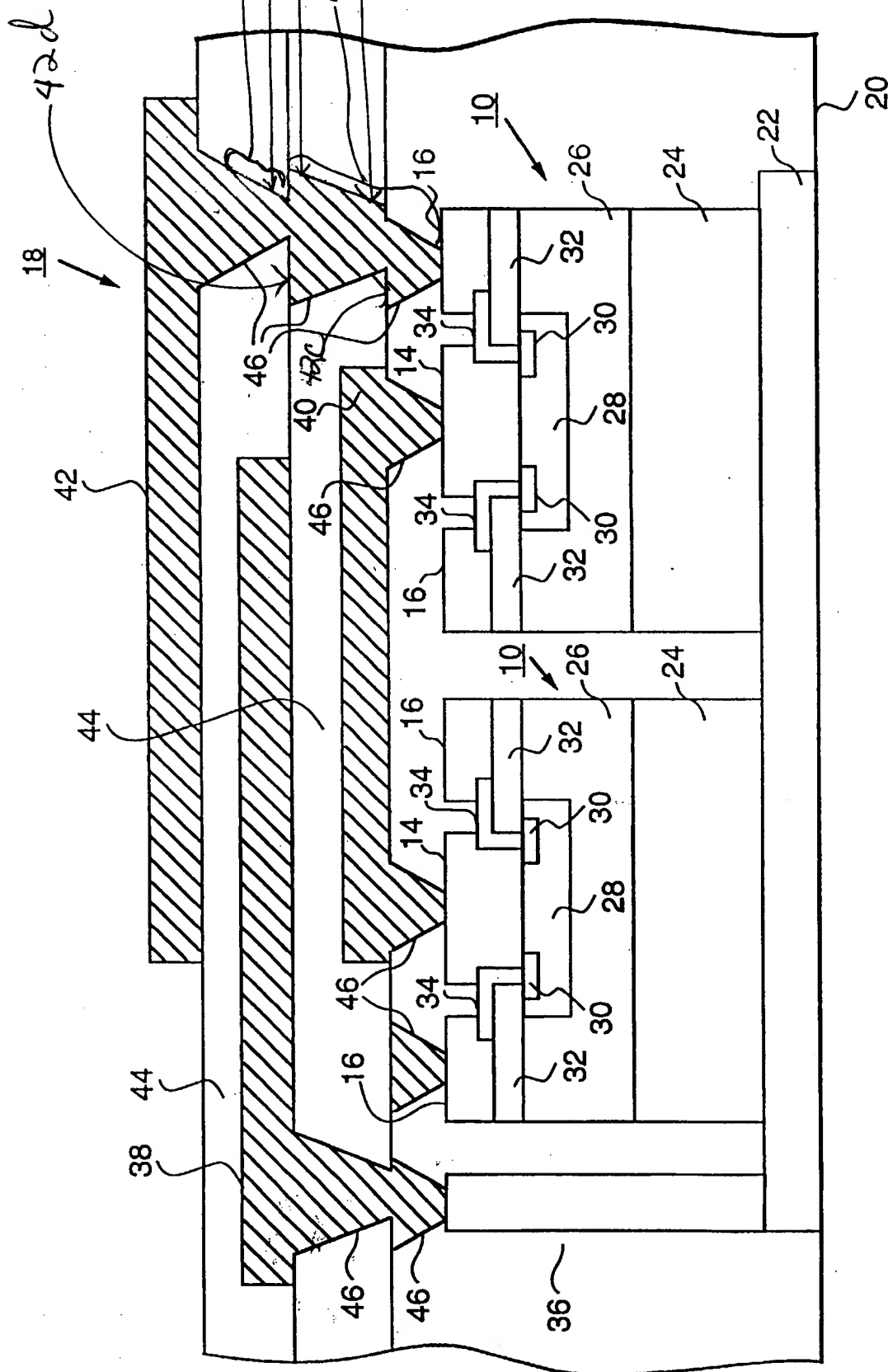


FIG. 3